MIG-21F/13

RANGE COMPUTER VRD-2A

No. 015.99.94

OPERATING AND MAINTENANCE INSTRUCTIONS

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C O N T E N T S

I. PURPOSE

The range computer, type ВРД-2А, serves to produce a voltage proportional to $\Delta V_{cp} = f(\frac{V_H}{H})$ for a range finder, type СРД.

Note: Further in the text the range computer, type ВРД-2А, will be termed "computer".

II. SET

The computer set consists of a unit presented in Fig.1 and a special screw-driver.

In the СРД system the computer is used to produce voltages to be summed up with the close-up speed. It operates from a signal of the ДВС-5 air speed transmitter which incorporates a temperature gauge, type П-5.

III. SPECIFICATIONS

1. Power supply.....	D.C. 27 V ± 7%; D.C. 25 - 30 V with setting accuracy of ± 0.1 V; A.C. 36 V ±5%, 400 c/s ± 2%
2. Altitude range.....	0.5 - 25 km.
True air speed range.....	300 - 2500 km/hr
Indicated air speed range.....	300 - 1500 km/hr
Permitted range.....	0.275 - 11.8 km.
$\frac{V_H}{H}$ ratio range.....	50 - 350 1/hr
3. Output voltage accuracy.....	± 4.5% at t = 20°C; ± 5% at t = -60°C and t = + 60°C An accuracy of ± 5.5% is permissible when the ВРД-2А unit is coupled with the ДВС-5 and П-5 devices

	An accuracy of ± 10% is permissible at the altitude of 1.5 km., speed of V = 525 km/hr in the temperature range from - 60°C to + 60°C
4. Vibration resistance.....	computer is vibration-proof in the frequency range from 20 to 200 c/s and acceleration of 4 g
5. Power consumed.....	D.C. - 10 W, max. A.C. - 12 VA, max.
6. Output potentiometer impedance.....	10,000 ohms
7. Weight.....	2200 gr, max.

IV. OPERATION PRINCIPLE

Permitted range is determined as follows:

$$Д_p = 3.06 \times 10^{-3} \left[\Delta V_{cp}(V_H, H) + Д\right] \text{km.},$$

where $Д_p$ - permitted range;

ΔV_{cp} - true air speed and altitude function;

V_H - true air speed at altitude H;

H - flight altitude;

Д - close-up speed.

The ДВС-5 transmitter produces a voltage proportional to the true air speed and the computer proper produces a voltage proportional to the flight altitude. Both voltages are converted by the computer to a voltage proportional to $\Delta V_{cp} = f\left(\frac{V_H}{H}\right)$ (See Fig.2).

The voltage proportional to Д according to $U_Д = 0.04$ Д is introduced by the СРД.

Since V_H and H are the functions of the static and dynamic pressures, the computer is built up on a barometric principle.

V. KEY CIRCUIT DIAGRAM

The computer is a potentiometer-type calculator being built up as a self-balancing bridge circuit, formed by potentiometers $П_4$, $П_6$, and $П_7$ (See Fig.3).

The output voltage of potentiometer $П_4$ (considering potentiometer $П_6$ load) is a function proportional to the true air speed:

$$U_1 = f_1 (V_H).$$

The voltage produced by potentiometer $П_6$ is a function inversely proportional to the altitude:

$$U_2 = f_2 (\frac{1}{H}).$$

Potentiometers $П_4$ and $П_6$ form a multiplier circuit, therefore, potentiometer $П_6$ produces voltage proportional to $V_H \times \frac{1}{H}$ which is defined as follows:

$$U = U_1 \times U_2 = f_1 (V_H) \times f_2 (\frac{1}{H}) = f_3 (\frac{V_H}{H}).$$

Voltage U actuates potentiometer $П_7$ by means of a magnetic amplifier and an electric motor, type ДИД-0,5. This operation is performed as follows: wipers of potentiometers $П_6$ and $П_7$ are connected to the magnetic amplifier input so that the potentiometer input voltage equals zero, if the potential difference between the circuit input and potentiometer $П_7$ wiper equals the potential difference between the circuit output and potentiometer $П_6$ wiper. In this case the magnetic amplifier input voltage equals zero, the ДИД-0,5 control winding voltage also equals zero, and as a result the wiper of potentiometer $П_7$ fails to move.

The key circuit diagram of the magnetic amplifier is presented in Fig.13.

If the voltage produced by potentiometer $П_6$ or $П_4$ is changed, some voltage appears at the amplifier input. This voltage is amplified and fed to the ДИД - 0,5, which moves potentiometer $П_7$ wiper through reductor P until circuit balance is restored, i.e. until the potential difference between the input and potentiometer $П_7$ wiper equals the potential difference between the output and potentiometer $П_6$ wiper.

Potentiometers $П_7$ and $П_8$ wipers are located on a common axle. Potentiometer $П_8$ serves to produce a voltage proportional to

$$\Delta V_{cp} = f\left(\frac{V_{II}}{H}\right).$$

Since potentiometer $П_8$ has a linear characteristic, its output voltage is also proportional to

$$\Delta V_{cp} = f\left(\frac{V_H}{H}\right).$$

According to the key circuit diagram (Fig.4) the voltage from the aircraft D.C. 27-V mains is fed to terminals 7 and 6 of plug connector $Ш_3$ of the computer. Positive voltage + 27 V is fed to terminal 4 of block A, and then to resistors R_{95} and R_6. Negative voltage - 27 V is fed to terminal 6 of plug connector $Ш_3$ terminal 5 of block A and resistor R_{36} in (input). A.C. 36 V, 400 c/s from the inverter, type ПАГ-1Ф or ПТ is fed to terminals 8, 10, and 12 of plug connector $Ш_3$ (Fig.4) to supply the magnetic amplifier and the ДИД-0,5 motor exciting winding. Output potentiometer $П_8$ of the computer is fed by a regulated voltage of 25 - 30 V (with an accuracy of ± 0.1 V) from the СРД unit through terminals 1 and 5 of plug connector $Ш_3$. Voltage supply from potentiometer $П_8$ wiper to the СРД unit is accomplished through terminal 9 of plug connector $Ш_3$.

D.C. 27 V is fed through absorbing resistor R_6 (in the computer circuit) and terminal 13 of plug connector $Ш_3$ to terminal 1 of plug connector $Ш_2$ (in the П-5 stagnation temperature gauge circuit) and, on the other hand, to terminal 7 of plug connector $Ш_1$ in the ДВС-5 transmitter.

In the computer provision is made for resistors R_5, R_6, and R_8 which are necessary to ensure operation of the computer in conjunction with the ДВС-5 transmitter.

Resistor R_5 serves to regulate scale speed. Resistor R_6 is an absorbing resistor in the П-5 gauge circuit.

Resistor R_8 serves to reduce voltage supplied to the magnetic amplifier of the ДВС-5 transmitter down to 18 V.

Resistors R_7, R_4 and potentiometer $П_6$ constitute a load of 121.5 ohms. Resistor R_{36} is used to ensure the circuit

balance and is connected between potentiometer $П_7$ in (input) and terminal - 27 V.

Potentiometer $П_8$ is a high-resistance one (10 kilohms) and serves to introduce a signal to the СРД system.

Shunts and additional resistors in potentiometers $П_6$, $П_7$, and $П_8$ are used to collect voltage from these potentiometers in a certain relationship.

In the computer use is made of a two-stage magnetic amplifier.

Principle of operation of the two-stage magnetic amplifier (Fig.13) is based on the property of the core material to reduce permeability under the action of the actuating signal (magnetization). With the input signal fed to control windings W_y, the current in feedback windings W_{oc} of one coil increases and in feedback windings W_{oc} of the other coil decreases. The same takes place in windings $W_{\sim 1}$ of both coils. As a result, unbalance of the differential arms of the first stage is created. Voltage of the unbalance is fed to the input bridge consisting of four windings and is amplified once more due to current difference in windings W_{y2} of the second stage. Thus, an output voltage appears at the amplifier. Resistors R_{20} and R_{21} serve to regulate the zero and amplification coefficient of the amplifier. Temperature is being compensated by copper resistor $R_{19м}$ and constantan resistor $R_{19к}$. Choke Др is installed to reduce supply voltage of the first stage from 36 V down to 14 V.

VI. CONSTRUCTION

The computer (Fig.1) consists of the following parts:

(a) altitude unit 1;

(b) follow-up unit 2;

(c) mounting support with amplifier 3.

Altitude unit is mounted in a hermetic housing, whose inner cavity communicates with the Pitot-static tube.

A stack of sealed bellows 2 serves as the sensitive element of the altitude unit (See Fig.5). The stationary

centre of the stack is fixed onto frame 1 and the movable one is connected to axle 11 by means of hinge 3, rod 9 and link 10. Besides, this axle mounts wiper holder 4 with wipers 5.

Terminal block 6 is fastened to frame 1 by screws 12, 13. This block carries potentiometer 8 and by-pass coils 7 as well. By-pass coils 7 are mounted onto pins which serve as terminals for soldering coils to corresponding sections of the potentiometer.

The housing pressurization is ensured by tightening cover 15 with the aid of screw collar 16.

Hookup wires are led out through sealed terminals 17 located in the bottom of the housing.

Follow-up unit is an independent system which consists of an electric motor with a reductor, a potentiometer unit, set of by-pass coils and switching elements for connecting the computer to the ДВС-5 and П-5.

The outer view of the follow-up unit is shown in Fig.7.

There are two ring-type potentiometers in the potentiometer unit (See Fig.8): one of them - follow-up potentiometer 1 and the other (2) is an output one. They are mounted on frame 6 of the follow-up unit.

ДИД-0,5 electric motor 4 and reductor 5 are mounted on the base of frame 6.

Common wiper holder 7 and current-carrying springs 8 are located on the axle which rotates on the bearings of plates 9.

By-pass coils 10 are mounted onto pins 11 of terminal block 13. The pins serve to connect by-pass coils 10 to corresponding sections of the follow-up potentiometer.

Adjustable rheostat 15, A.C. absorbing resistor 16, load resistor 17, absorbing resistor 18, circuit balancing resistor 19 and terminal blocks 20 are located on base plate 14, which is fastened to frame 6 by means of screws.

The follow-up unit is covered by housing 12 and is fixed in the recess of the altitude unit housing by screws.

The hookup wires of the follow-up unit and the hookup wires of the altitude unit are bunched together constituting one bunched conductor 21 and are connected to the plug connector of the mounting support.

The scale of the follow-up unit is graduated in $\frac{V_H}{H}$ (1/hour).

Mounting support with the amplifier is also an independent unit (See Fig.9). The mounting support serves to mount the ДВС-5 transmitter and to couple it with the magnetic amplifier.

The mounting support consists of plate 1 and panel 5. Fastened to the bottom of plate 1 by means of four nuts 3 is magnetic amplifier 2. The upper side of this plate mounts the transmitter which is fixed by screws 18 and metallic strips.

Riveted to the plate end face is block 20 which is connected to a cable with type 2РМ24Б19Ш181 plug connector 21.

Plate 1 on which the transmitter and the amplifier are mounted is attached to panel 5 by screws 6 and four pairs of shock absorbers 22, types 271С-49-1-1 and 271С-49-1-2, which ensure the instrument vibration resistance.

Four rubber washers 8 attached to the lower shock absorbers by screws 6 and nuts 9 protect the equipment against impact load. There are four slots to attach mounting support 5 to the shock absorbers.

Magnetic Amplifier
(Fig.10)

The magnetic amplifier is mounted in housing 1; it consists of:

(1) two toroidal chokes 2 of the first stage;
(2) two chokes 3 with three-leg cores of the second stage;
(3) two selenium rectifiers 4;
(4) absorbing choke;
(5) condenser, type МБГП (0.5 μF);
(6) adjustable rheostat 6;
(7) two adjusting resistors;
(8) МЛТ-0,5 resistor 7.

Toroidal choke 2 has a core composed of a set of rings made of permalloy, grade 79НМ, 0.35 mm thick. This permalloy ring set is inserted into a special aluminium holder which prevents mechanical damage to the core during winding of the coil and compensates ambient temperature changes.

The holder is wrapped with varnished cambric which carries the A.C. winding. Two such cores with A.C. windings are put together and wrapped with varnished cambric. A feedback winding and an input winding insulated from one another are wound onto the paired core. The coils are insulated from one another.

The choke core of the second stage is composed of Ш-type plates made of steel, grade Э-44.

Absorbing choke 5 consists of a spool with winding (wire, type ПЭВ-2, ø 0.15) and a core composed of Pi-shaped plates made of steel, grade Э-44.

Selenium rectifier 4 consists of five selenium plates and five spring washers fixed on a stud. The rectifier is filled with a compound to ensure isolation of the selenium plates from the ambient air.

Adjustable rheostat 6 is wound of constantan wire, mark ПЭК, ø 0.15, with 50 - 60 ohm resistance.

Wire leads of the magnetic amplifier are bunched together and connected to the common block attached to the mounting support.

VII. MAINTENANCE AND OPERATION

1. Preinstallation Check

Prior to installation, the computer should be connected to the ДВС-5 and П-5 according to the connection circuit diagram for the ДВС-5 and the ВРД-2А (See Fig.11).

1. Supply the voltage indicated in the computer Certificate to terminals 1 and 5 of plug connector Ш3.

2. Set the power source to supply A.C. 36 V ± 5%, 400 c.p.s. ± 2% and D.C. 27 V ± 7%.

3. See to it that appropriate velocity head ΔP and static pressure P (See Table 1) are created in the range required for the computer and the ДВС-5 check, making use of the pneumatic installation shown in Fig.14.

Table 1

H	P	V	ΔP	Output voltage in V, at ambient temperature in °C as read by the Π-5 temperature gauge													Tolerance
km.	mm Hg	km/hr	mm Hg	- 60	- 50	- 40	- 30	- 20	- 10	0	+ 10	+ 20	+ 30	+ 40	+ 50	+ 60	%
1.5	636.5	525	85.5	5.9	5.7	5.6	5.4	5.3	5.2	5.2	5.1	5.0	5.0	5.0	5.0	5.0	10
2	598.4	500	72.3	9.2	9.1	8.9	8.8	8.7	8.3	8.2	8.1	7.9	7.8	7.6	7.3	7.2	5.5
4	463.9	1200	483.9	7.7	7.4	7.2	6.9	6.8	6.6	6.3	6.2	5.9	5.8	5.6	5.5	5.4	5.5
5	406.5	1000	250.8	12.0	11.6	11.4	11.2	10.9	10.6	10.4	10.1	10.0	9.8	9.7	9.5	9.4	5.5
8	267.9	1200	279.5	15.7	15.4	15.1	14.8	14.6	14.3	14.1	13.9	13.6	13.4	13.2	13.0	12.8	5.5
10	198.9	1000	122.7	20.4	20.2	19.9	19.7	19.4	19.0	18.8	18.7	18.4	18.3	18.1	17.9	17.6	5.5
20	41.1	1600	109.4	23.2	22.9	22.7	22.4	22.2	21.9	21.7	21.4	21.2	21.0	20.9	20.8	20.7	5.5
25	18.7	1500	39.9	27.0	26.4	26.1	25.8	25.7	25.3	25.0	24.9	24.6	24.5	24.3	24.2	24.0	5.5
25	18.7	2500	476.9	20.4	20.2	19.9	19.7	19.4	19.0	18.8	18.7	18.4	18.3	18.1	17.9	17.6	5.5

Appropriate ΔP and P are set according to Table 1 and U_{out} value is determined depending on the ambient temperature read by the П-5 gauge.

For this purpose a high-resistance voltmeter with internal impedance of 100 kilohms is connected to pins 5 and 9 of plug connector Ш3 (it is recommended to make use of device Ц-5 for installation ППТВ-1).

The computer error is determined as follows:

$$\delta = \frac{U_{calc} - U_{meas}}{U_{calc}} \times 100\%,$$

where δ - error at a given value of ΔV_{cp};

U_{calc} - calculated value of ΔV_{cp} in volts;

U_{meas} - measured value of ΔV_{cp} in volts.

If the errors exceed the permissible values, it is recommended to vary the true air speed signal, making use of rheostat R_5 included in the computer circuit, thus increasing or decreasing the computer $\frac{V}{H}$ readings.

Notes: 1. If the attempts to adjust the ВРД-2А computer connected to the ДВС-5 and the П-5 by means of the rheostat give no effect, an additional adjustment is permitted by supplying a voltage of 25 - 30 V to the ВРД -2А output potentiometer. It should be registered in the computer Certificate.

2. Rheostat R_5 slider should be displaced by means of a screw-driver furnished with the ВРД -2А computer.

When using the ВРД-2А computer in conjunction with the ДВС-5 and П-5, the number of the ДВС-5 transmitter should be registered in the computer Certificate.

This done, check the computer operating in conjunction with the СРД system in accordance with Instructions on the СРД and the computer coupling.

Note: Instructions on checking the ВРД-2А operation in conjunction with the СРД are included in the СРД description and are also given in the present Instructions.

2. Installation Requirements

The computer is mounted on a shock-absorbing base in any suitable site of the aircraft, provided the following requirements are met:

1. The computer scale should be easily observed during check.

2. The shock-absorbing base should be in horizontal position during flight.

3. Vibration acceleration at the computer attachment place should be in compliance with the computer Specifications.

4. The computer installation place should be selected so as to ensure the most convenient connection of the computer pipe union to the ПВД static system. It is desirable that this installation place should be above the ПВД system.

Provision should be made for a moisture trap and a drainage system to protect the equipment against moisture.

5. Pneumatic line connection should be sealed according to the aircraft pneumatic line standards.

6. Provision should be made for the equipment free movement on the shock-absorbers to protect it from impacts against adjacent objects.

7. The equipment cable and pneumatic hose should be attached to the fuselage in such a way as to provide the computer free travel and self-setting (without hose tension).

8. The computer connection to the ДВС-5 and the П-5 should be performed in accordance with the ДВС-5 and the ВРД-2А cable connection diagram (See Fig. 11).

Note: All the computer installation requirements concern also the ДВС-5 transmitter.

Installation and overall dimensions of the computer are shown in Fig.12.

9. The П-5 should be installed on the fuselage in accordance with the requirements for stagnation gauge installation.

3. Postinstallation Check

1. Check the computer for proper installation.
2. Check the pneumatic lines for airtightness.
3. Check the computer connected to the ДВС-5, П-5 and СРД for serviceability.

4. Preflight Check

1. Check visually the computer for intactness, its connection to the ДВС-5, the П-5; check the ДВС-5 and П-5 for proper attachment; the electric wiring continuity and the plug connectors serviceability.
2. Check the computer connected to the ДВС-5, П-5, and СРД for serviceability.

5. Scheduled Maintenance Operations

Checking after 10 hours of operation (minimum once every month).

Perform the preflight checking.

Checking after 25 hours of operation (minimum once every 3 months).

Perform the 10-hour scheduled maintenance operations.

Check the pneumatic lines for airtightness.

Checking after 50 hours of operation (minimum once every 6 months).

Perform the 25-hour scheduled maintenance operations.

Check the computer accuracy during its operation in conjunction with the СРД.

6. Checking Procedure

(a) Installation Check

When checking the equipment for proper installation, it is necessary to examine attachments of the ВРД-2А, ДВС-5, and П-5 to the aircraft structure and to make sure that all the installation requirements are met.

(b) Pneumatic Lines Airtightness Check

The airfield installation, type КПУ-3, used for testing air-speed indicators should be connected to the ПВД Pitot-static tube coupled with the ВРД-2А and the ДВС-5. Then the pneumatic lines of the ВРД-2А operating with the ДВС-5 are checked for airtightness in accordance with aircraft pneumatic lines standards.

(c) Checking Computer Serviceability on Board Aircraft

The computer serviceability is checked by actuating it together with the ДВС-5, the П-5, and the СРД as follows:

1. Switch on toggles RANGE FINDER (РАДИОДАЛЬНОМЕР) and ВРД-2А.

2. Connect the high-resistance voltmeter to check terminals C and OUT of unit 8 of the range finder.

3. Using the КПУ-3 airfield installation introduce an altitude of 1 - 2 km. to the computer and the ДВС-5 transmitter through the ПВД static vents, the ПВД dynamic vent remaining open. In this case the scale of the computer should begin to rotate counter-clockwise until maximum value of $\frac{V_H}{H}$ is reached. The voltmeter reading should reduce from 27 V to ~5 V.

Reducing the altitude to zero make sure that the computer scale moves in the direction of reduction of the $\frac{V_H}{H}$ values, and the voltage on terminals C and OUT of range finder unit 8 increases from ~5 V to 27 V.

The check over, switch off toggles RANGE FINDER (РАДИОДАЛЬНОМЕР) and ВРД-2А.

(d) Checking ВРД-2А Accuracy during Operation Together with ДВС-5, П-5 and СРД on Board Aircraft

1. Set an altitude of 5 km. by the КПУ-3 through the ПВД static vents. The dynamic vent of the ПВД remains open. Prior to this, set the day ambient air pressure and the altitude above sea level on the reference altimeter by a rack. This altitude should correspond to the day ambient air pressure considering the altimeter corrections (See Note 3 of Item 2 below).

Check the voltage between the C and OUT terminals of range finder unit 8. It should be within 8.7 ± 0.56 V.

2. Set an altitude of 10 km., conditions being similar to those listed in Item 1.

The voltage between terminals C and OUT of СРД unit 8 should be within 12.9 ± 0.6 V.

Note 1. The ВРД-2А check in accordance with Items 1 and 2 is valid only at the ambient air temperature of + 20° ± 2°C as read by the П-5 gauge. At any other ambient temperature make use of the following Table.

T a b l e

for Checking the ВРД-2А at Various Ambient Temperatures as Read by the П-5

Ambient temperature as read by П-5 gauge	Voltage should be rated	
	for altitude H = 5 km.	for altitude H = 10 km.
1	2	3
- 60	9.8 - 10.9	13.9 - 15.3
- 50	9.5 - 10.6	13.6 - 15.1
- 40	9.5 - 10.5	13.5 - 14.9
- 30	9.3 - 10.3	13.1 - 14.5
- 20	9.0 - 9.9	12.9 - 14.3

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1	2	3
- 10	8.8 - 9.7	12.8 - 14.1
0	8.7 - 9.6	12.5 - 13.9
+ 10	8.6 - 9.5	12.4 - 13.7
+ 20	8.2 - 9.1	12.3 - 13.5
+ 30	8.1 - 9.0	12.2 - 13.4
+ 40	8.0 - 8.9	11.5 - 12.8
+ 50	7.8 - 8.6	11.2 - 12.4
+ 60	7.7 - 8.5	10.9 - 12.1

2. The ДВС-5 and ВРД-2А scales are reference ones and serve only to determine general serviceability of these units.

3. If the day ambient air pressure does not equal 760 mm Hg when setting the altitude by the reference altimeter (ВД-20), it is necessary to make use of the following Table:

Day ambient air pressure set by rack of ВД-20, mm Hg	Readings fixed at altitude H = 0 by rack of ВД-20	Altitude set by ВД-20 (for H = 5 km.), m.	Altitude set by ВД-20 (for H =10 km.), m.
790	- 330	4500	9100
780	- 200	4700	9400
770	- 100	4830	9700
762.76	0	5000	10,000
750	+ 100	5200	10,380
740	+ 200	5400	10,700
730	+ 330	5500	11,100

For intermediate values of the day ambient air pressure (Column 1), intermediate values for magnitudes in Columns 2,3, and 4 should be determined.

EXAMPLE: The day ambient air pressure is 790 mm Hg. Checking is performed for H = 5 km.

Set an altitude of 330 m. by the knob of the ВД-20 altimeter and set the bigger pointer to position 670 m. moving it counter-clockwise.

Slacken the self-locking nut, set the day ambient air pressure (790 mm Hg) by the rack and lock the self-locking nut.

Set a pressure of 4.5 km. on the altimeter and measure the voltage in accordance with Item 1. For the given data the altimeter error is considered to be equal to zero.

Pneumatic Installation Maintenance Instructions

The pneumatic installation consists of elements 2,3,5, 6, 6′, 7, 8, 9, 10, and 11 (See Fig. 14) and serves for altitude and speed simulation in the pneumatic system of the ВРД-2А and the ДВС-5 under test.

Altitude Setting

1. H = 0.

(a) Open cock 7 (cocks 6, 6′, 8, and 9 are closed; cocks 10 and 11 are open) so that the readings of barometer 2 correspond to the atmospheric pressure at the test site. Thereafter cock 7 should be closed.

(b) If the atmospheric pressure at the test site is such that barometer 2 reading sets above H = 0, reduce it down to H = 0 by opening cock 8. This done, close cock 8.

(c) If the atmospheric pressure is such that the barometer reading sets below H = 0, adjust it to read H = 0 by opening cock 6. Thereafter cock 6 should be closed.

2. H ≠ 0.

(a) Open cock 6 (cocks 6′, 7, 8, and 9 are closed, cocks 10 and 11 are open), adjust the reading of barometer 2 to the required altitude and close cock 6.

When adjusting the reading of barometer 2 to the required altitude maintain pressure using mercury gauge 3 by gradually opening cock 6' .

(b) Reduce the altitude by opening cock 7 (cocks 10 and 11 are open).

Speed Setting

1. H =0.

(a) Open cock 8 (cocks 6', 6, 7, 9, and 10 are closed, cock 11 is open) and adjust mercury gauge 3 reading to the required speed. Thereafter cock 8 should be closed.

(b) Speed reduction is performed by opening cocks 9 and 11.

2. H ≠ 0.

(a) Open cock 8 (cocks 6' , 6, 7, 8, and 10 are closed) and adjust mercury gauge 3 reading to the required speed. Thereafter cock 8 should be closed.

(b) Speed reduction is performed by opening cock 6' .

Altitude Change at Preset Speed

Reduce the preset speed value to zero, using cocks 10 and 11. This done, change the altitude as described above.

7. Faults and Remedies

Fault	Cause	Remedy
1	2	3
1. ВРД-2Afails to operate. With speed introduced, scale does not rotate	(a) Damage in ВРД-2А supply circuit (b) Faulty ВРД-2А	Find damage using ohmmeter and remedy it Check ВРД-2А serviceability in laboratory or in workshop and replace it, if necessary

1	2	3
2. When switching on, ВРД-2А and ДВС-5 scales rotate up to stops, beyond maximum values of speed and $\frac{V_H}{H}$	(a) D.C. wrong polarity (b) Poor contact in plug connector of П-5 gauge	Change power supply polarity Tighten plug connector of П-5 and remedy wiring, if necessary
3. ДВС-5 fails to operate. With speed introduced, scale does not rotate	(a) Damage in supply circuit (b) Faulty ДВС-5	Find damage and remedy it Check ДВС-5 serviceability in laboratory or in workshop and replace it, if necessary

8. Unit Operation

In flight the computer does not require any adjustment or regulation.

9. Storage

1. The computer should be packed in a special box.

2. The box should be glued by water-proof glue. A printed label should be glued to the end face of the box. The label should contain the following data:

- article name;
- number;
- date of manufacture;
- packager number;
- message number;
- service life;
- article storage life without checking.

3. The box should be placed into a rigid case suitable for transportation by railroad or by truck.

The case should be made of a material with moisture content of not over 15 - 20%.

A spacer made of water-proof paper (bituminous or tar) should be provided between the case and the box.

4. The box should tightly fit the case to prevent the box shifting during transportation.

5. Two outer sides of the case should carry the following inscriptions: HANDLE WITH CARE, DO NOT DROP, THIS SIDE UP and OPEN HERE.

6. The unit should be stored in a special room at a temperature of 20 - 10°C and relative humidity of 60± 20%.

There should be no chemical reagents in the room which might cause damage to the article.

[redacted] 25X1

[redacted] 25X1

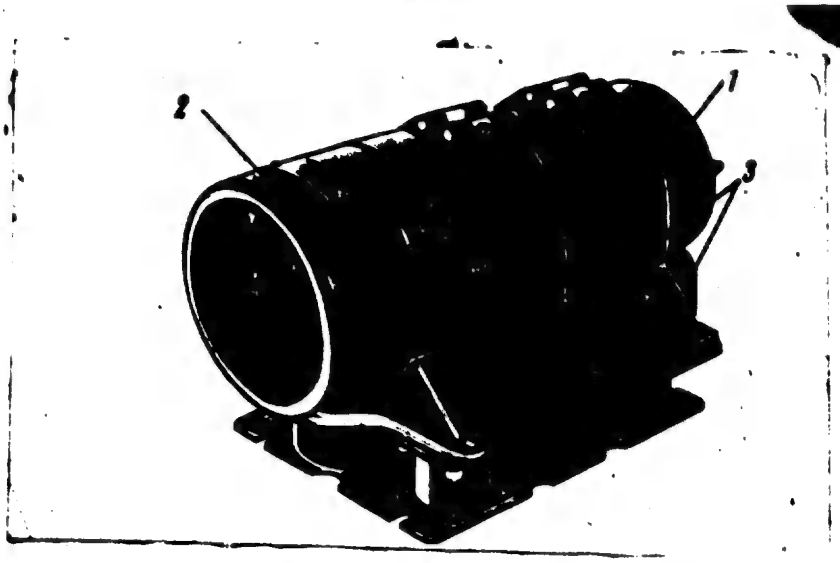

Fig. 1. Range Computer, Type ВРД-2А

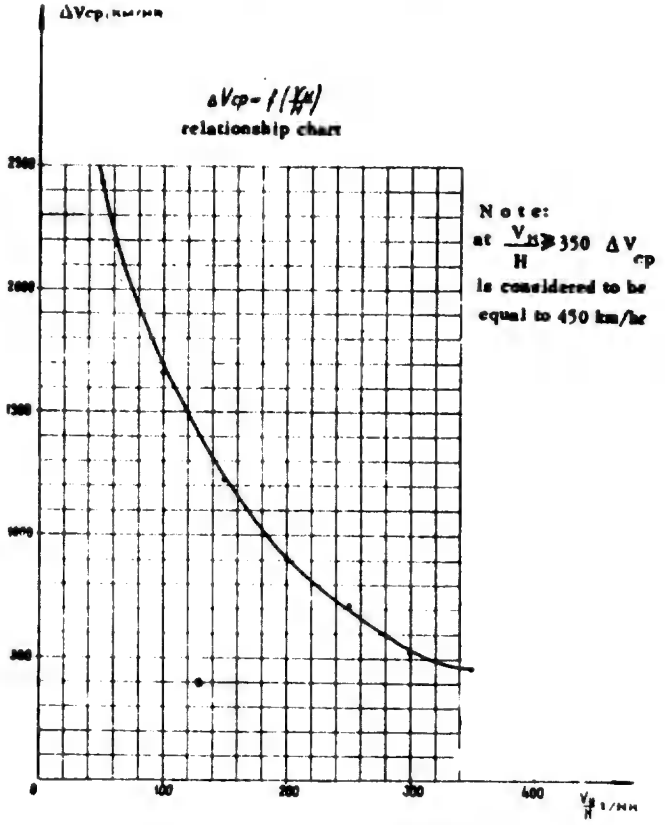

Fig. 2. $\Delta V_{cp} = f\left(\frac{V_H}{H}\right)$ Relationship Chart

SECRET

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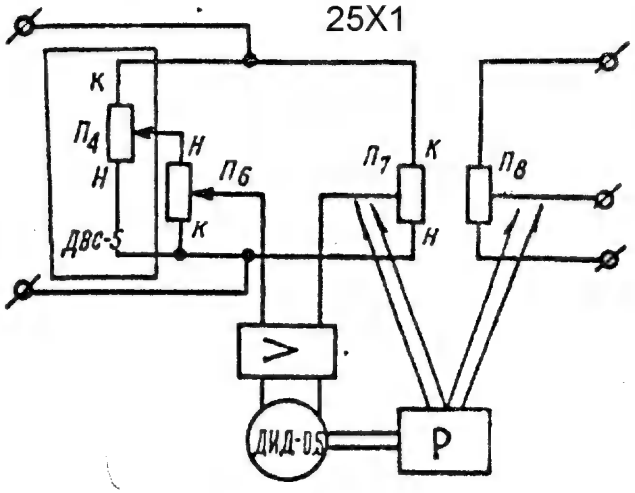
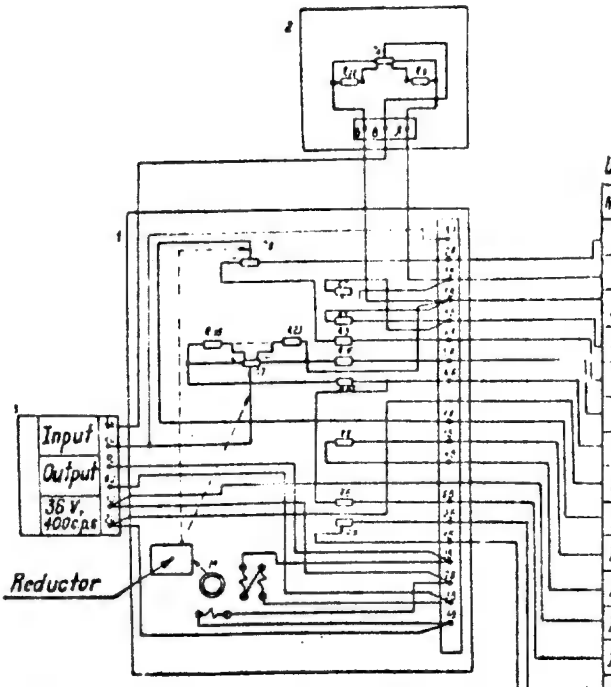


Fig. 3. Self-Balancing Bridge



Ш3

Nos	Designation	Connected to	Code
1	Voltage stabilizer+(25-30V)	Ш4-14	СРД
2	Output signal wiper	Ш1-2	ДВС-5
3	Midpoint	Ш1-3	ДВС-5
4	Output signal wiper 1	Ш1-4	ДВС-5
5	Voltage stabilizer-(25-30V)	Ш4-15	СРД
6	Supply voltage -27 V	Aircraft mains Ш1-6, Ш1-1	ДВС-5
7	Supply voltage+27 V	Aircraft mains Ш1-5	ДВС-5
8	Supply voltage 36V, 400cps	Terminal 3 or terminal 3 of Ш1-9	ПАГ-1Ф or ПТ-125, ПТ-200, ДВС-5
9	ВРД-2А signal wiper	Ш4-16	СРД
10	36 V, 400 c.p.s.	Terminal 5 or 1	ПАГ-1Ф or ПТ-125, ПТ-200
11	18 V, 400 c.p.s.	Ш1-11	ДВС-5
12	36 V, 400 c.p.s.	Terminal 4 or 2 of Ш1-10	ПАГ-1Ф or ПТ-125, ПТ-200, ДВС-5
13	Voltage of 7-9V	Ш2-1 Ш1-7	П-5, ДВС-5
14	Inlead of scale resistor R_5	Ш1-8	ДВС-5
15	Outlead of scale resistor R_5	Ш2-2	П-5

Fig. 4. ВРД-2А Key Circuit Diagram

List of Elements

Ref. No.	State Standard, Specifications, Standard, Drawing	Designation and type	Main data	Qnty	Note
1	655.98.08	Follow-up unit		1	
2	655.98.37	Aneroid unit		1	
3	676.97.20	Magnetic amplifier		1	
Ш3	2РМ24Б19Ш1А1	Plug connector of ВРД-2А		1	

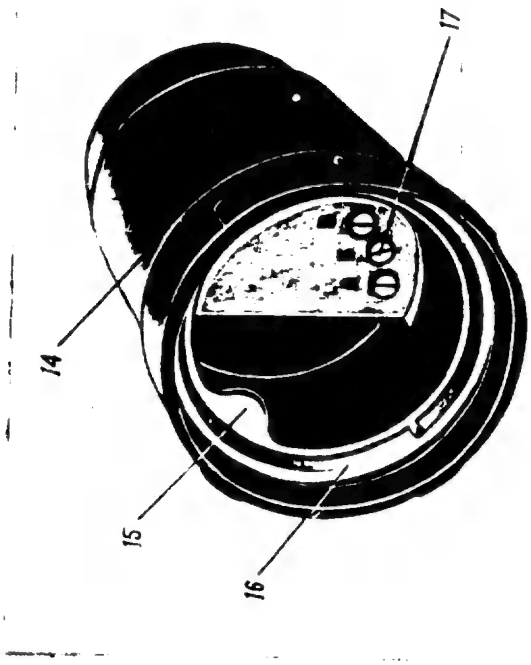


Fig. 6. Altitude Unit

Fig. 7. Follow-Up Unit Outer View

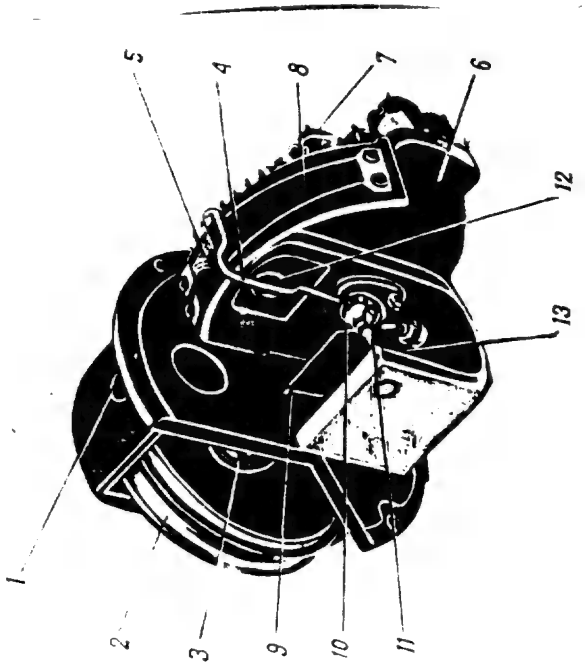


Fig. 5. Altitude Unit (with housing removed)

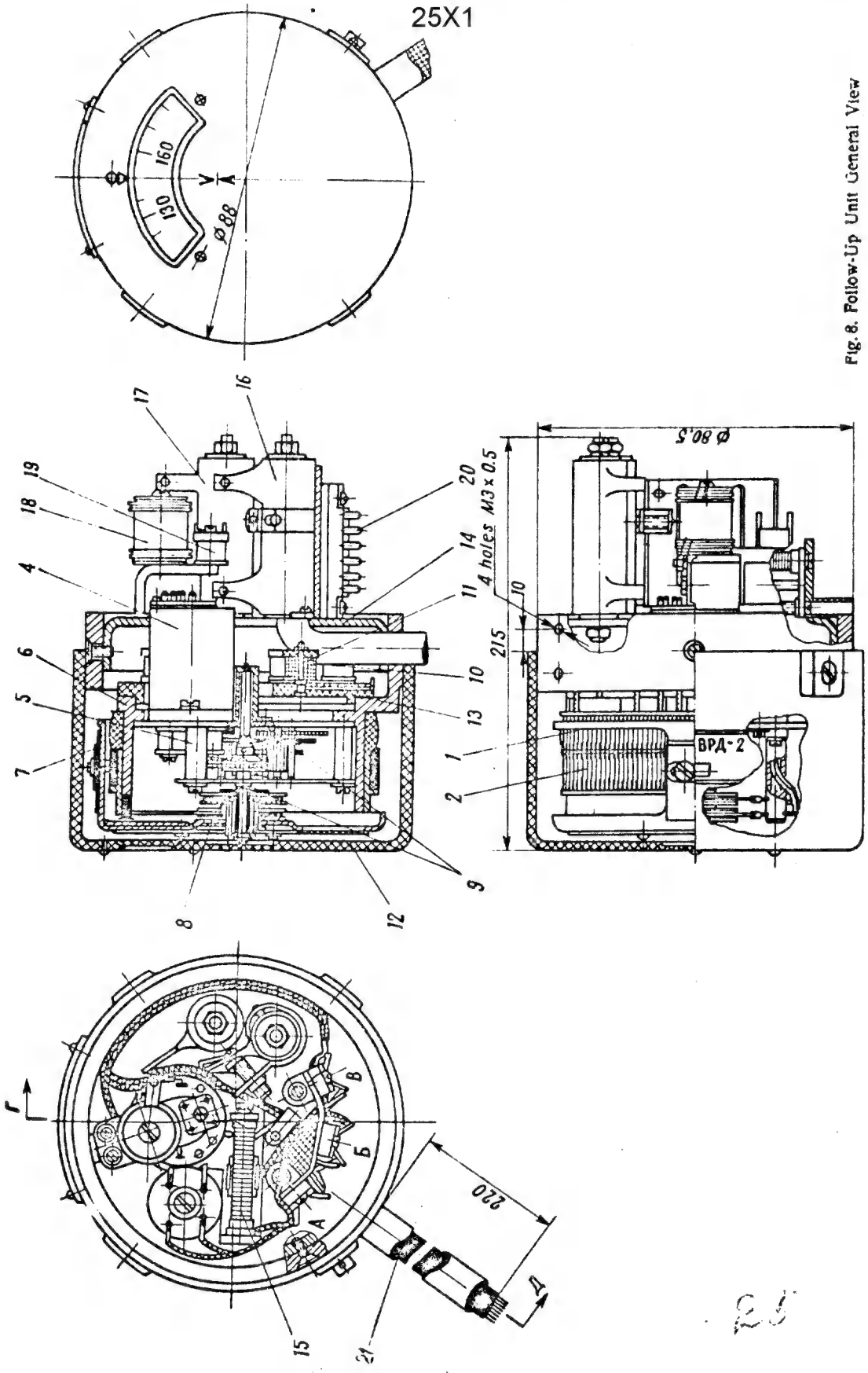


Fig. 8. Follow-Up Unit General View

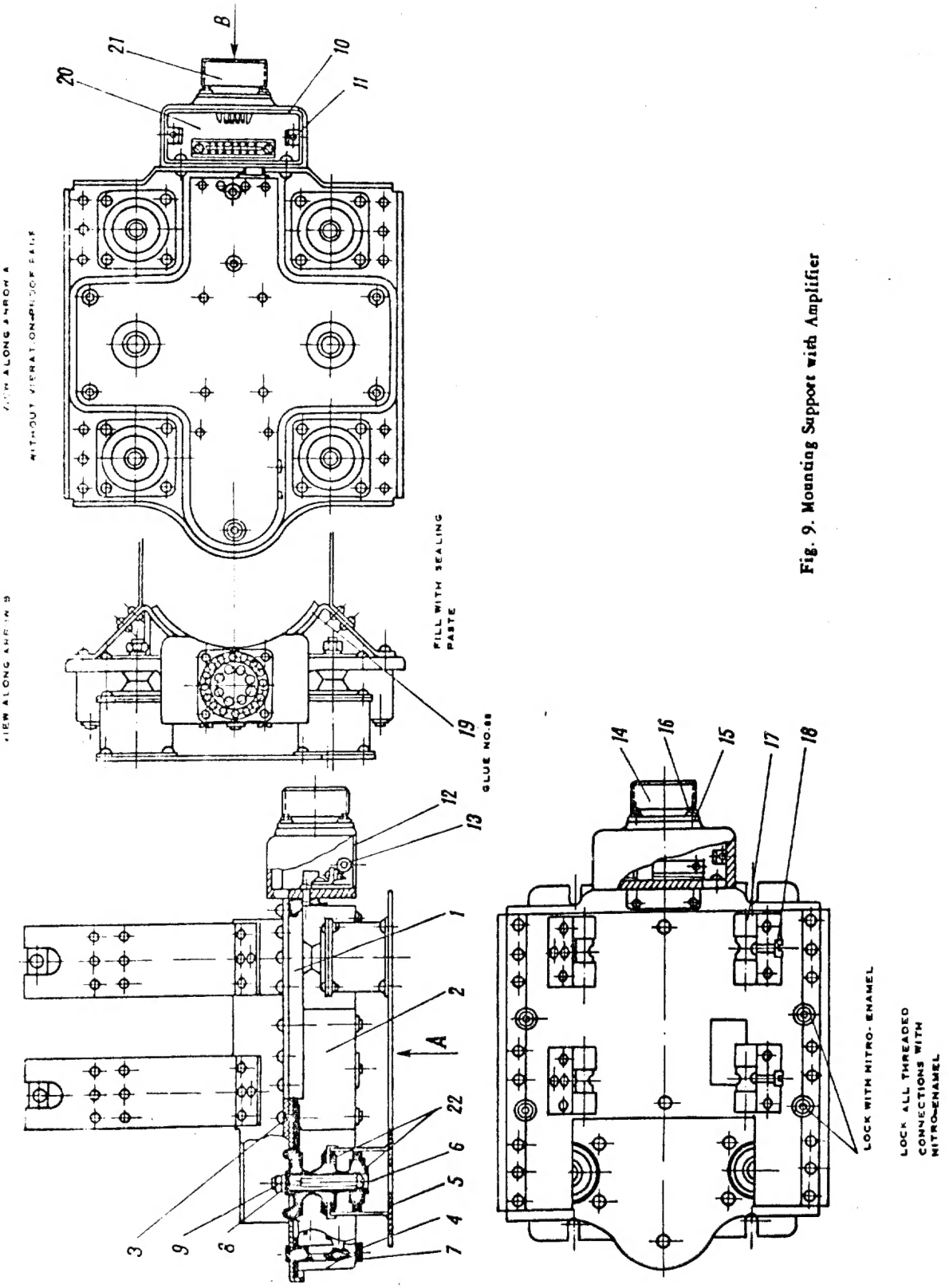


Fig. 9. Mounting Support with Amplifier

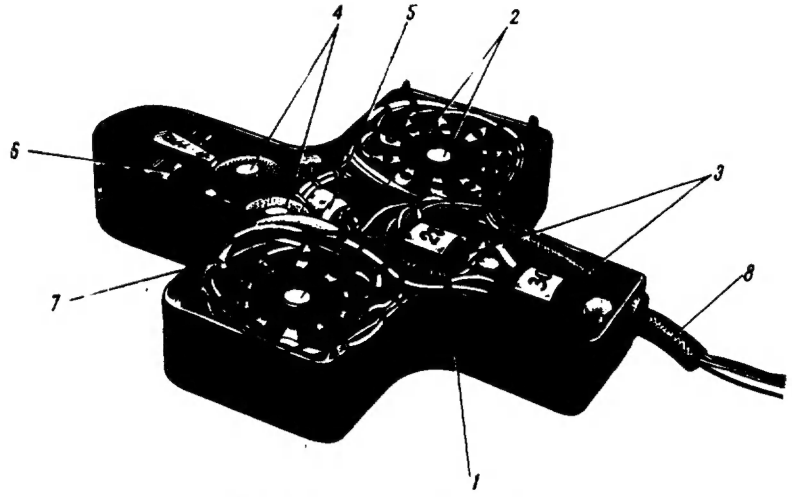


Fig. 10. Magnetic Amplifier Outer View

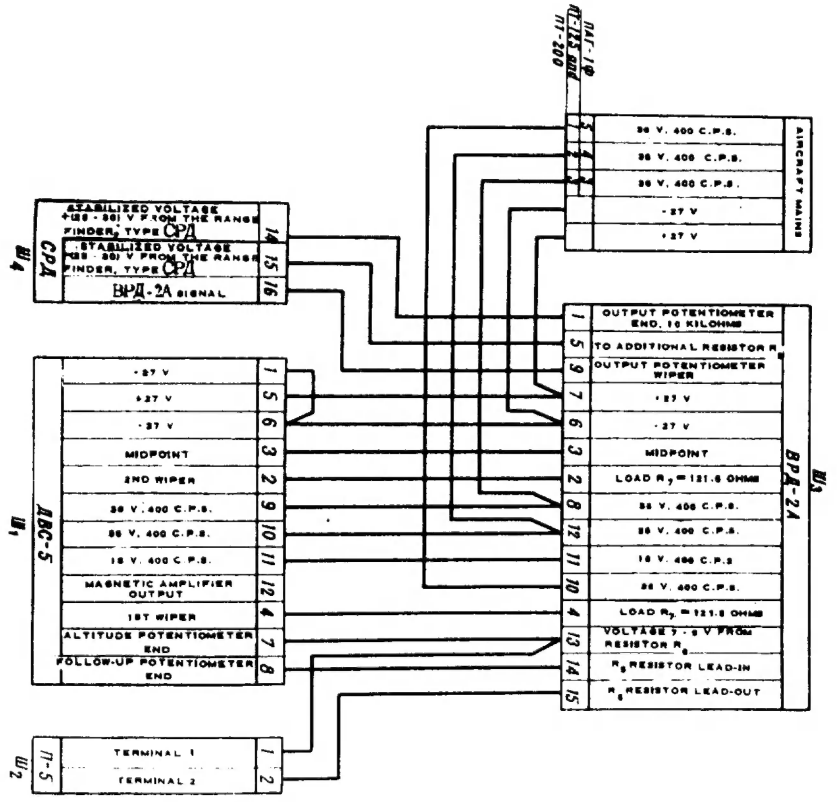


Fig. 11. Cable Connection Diagram of ДВС-5 and ВРД-2А

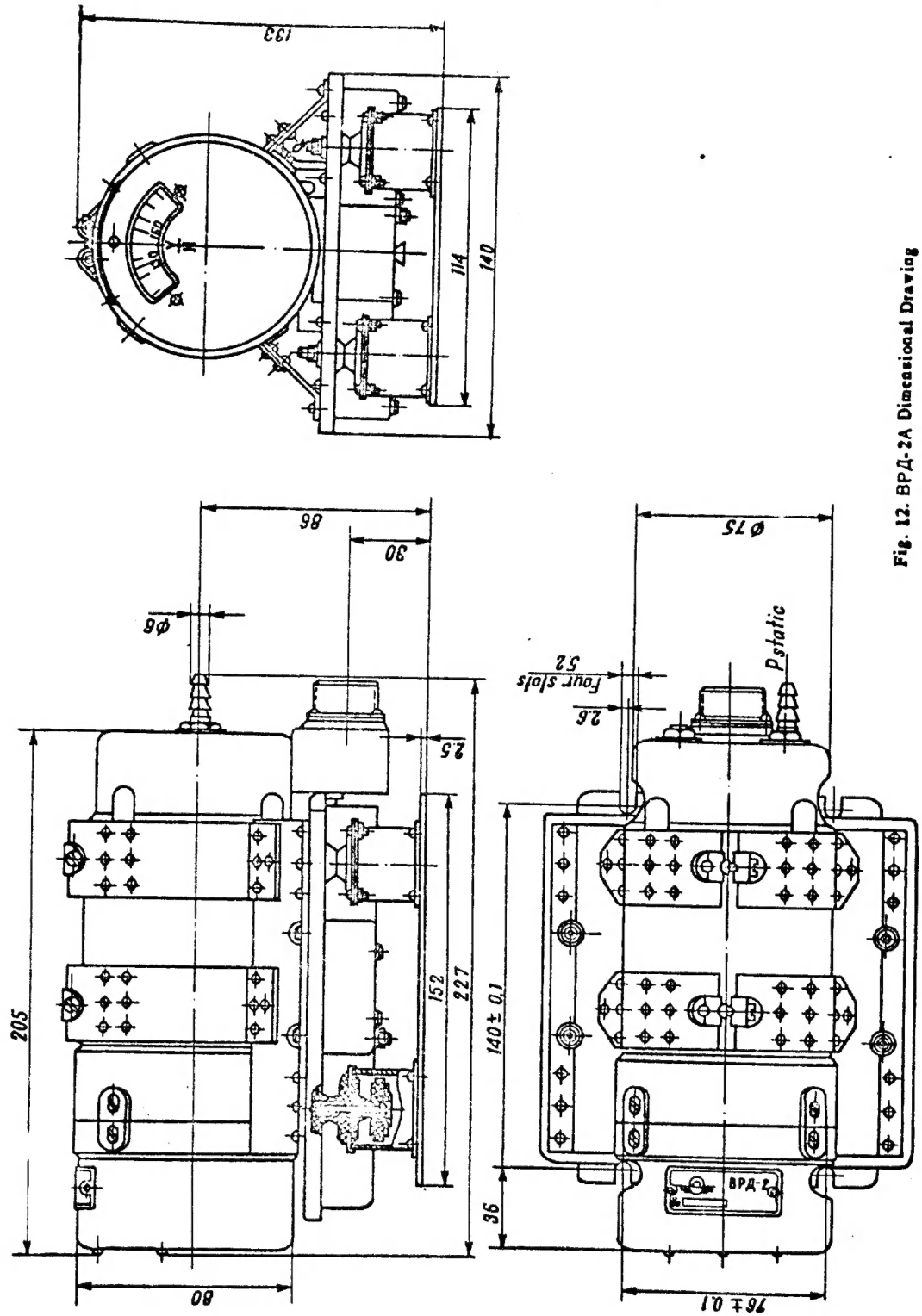


Fig. 12. ВРД-2А Dimensional Drawing

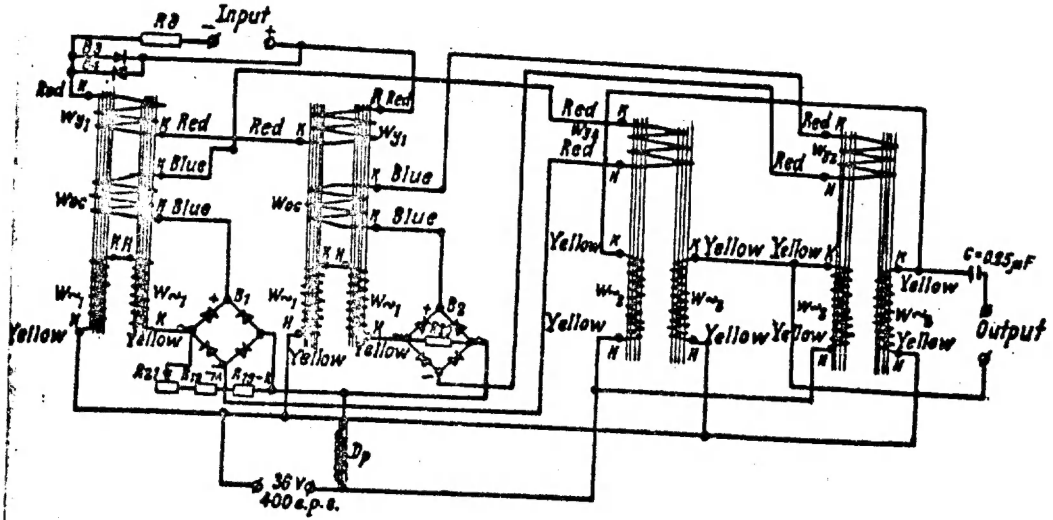


Fig. 13. Key Diagram of Magnetic Amplifier

PNEUMATIC INSTALLATION BLOCK-DIAGRAM

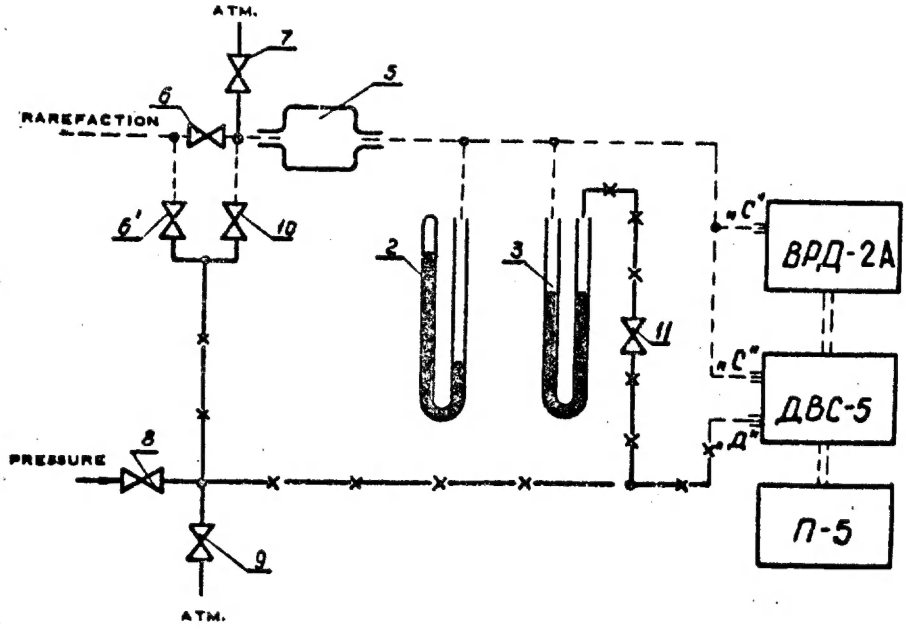


Fig. 14. Pneumatic Installation Block-Diagram